

CLAIMS

1. A plasma enhanced chemical vapor deposition method of forming a titanium silicide comprising layer over a substrate using a reactive gas comprising TiCl_4 and at least one silane, comprising:

providing a substrate within a plasma enhanced chemical vapor deposition chamber;

first feeding TiCl_4 to the chamber without feeding any measurable silane to the chamber for a first period of time; and

after the first feeding for the first period of time, second feeding TiCl_4 and at least one silane to the chamber for a second period of time effective to plasma enhance chemical vapor deposit a titanium silicide comprising layer on the substrate.

2. The method of claim 1 wherein the second feeding occurs at selected chamber deposition pressure and substrate temperature conditions, the first feeding also occurring at the selected second feeding chamber deposition pressure and substrate temperature conditions.

3. The method of claim 1 wherein the feeding of TiCl_4 during the first and second feedings is at a substantially constant volumetric flow rate.

4. The method of claim 1 wherein the feeding of TiCl_4 during the first and second feedings is at different volumetric flow rates.

5. The method of claim 1 wherein nothing other than TiCl_4 is fed to the chamber during the first period of time.

6. The method of claim 1 wherein the first period of time is less than the second period of time.

7. The method of claim 1 wherein the first period of time is no greater than 5 seconds.

8. The method of claim 1 wherein the first period of time is no greater than 3 seconds.

9. The method of claim 1 wherein,
the second feeding occurs at selected chamber deposition pressure and substrate temperature conditions, the first feeding also occurring at the selected second feeding chamber deposition pressure and substrate temperature conditions; and

the first period of time is less than the second period of time.

10. The method of claim 1 wherein the first feeding comprises plasma generation within the chamber.

11. The method of claim 1 wherein the first feeding does not comprise plasma generation within the chamber.

12. A plasma enhanced chemical vapor deposition method of forming a titanium silicide comprising layer over a substrate, comprising:

providing a substrate within a plasma enhanced chemical vapor deposition chamber;

first feeding TiCl_4 and at least one silane to the chamber at or above a first volumetric ratio of TiCl_4 to silane for a first period of time, the first volumetric ratio being sufficiently high to avoid measurable deposition of titanium silicide on the substrate; and

after the first feeding for the first period of time, second feeding TiCl_4 and at least one silane to the chamber at or below a second volumetric ratio of TiCl_4 to silane for a second period of time, the second volumetric ratio being lower than the first volumetric ratio, the second feeding being effective to plasma enhance chemical vapor deposit a titanium silicide comprising layer on the substrate.

13. The method of claim 12 wherein the first volumetric ratio is 500:1.

14. The method of claim 12 wherein the first volumetric ratio is 750:1.

15. The method of claim 12 wherein the first volumetric ratio is 1000:1.

16. The method of claim 12 wherein the first feeding is at a substantially constant volumetric ratio of TiCl_4 to all silane during the first period of time.

17. The method of claim 12 wherein the first feeding is at multiple volumetric ratios of TiCl_4 to all silane during the first period of time.

18. The method of claim 12 wherein the feeding of TiCl_4 during the first and second feedings is at a substantially constant volumetric flow rate.

19. The method of claim 12 wherein the feeding of TiCl_4 during the first and second feedings is at different volumetric flow rates.

20. The method of claim 12 wherein nothing other than TiCl_4 and silane is fed to the chamber during the first period of time.

21. The method of claim 12 wherein the TiCl_4 and silane are fed to the chamber from separate injection ports during the first feeding.

22. The method of claim 12 wherein the TiCl_4 and silane are mixed prior to feeding to proximate the substrate within the chamber during the first feeding.

23. The method of claim 12 wherein the second feeding occurs at selected chamber deposition pressure and substrate temperature conditions, the first feeding also occurring at the selected second feeding chamber deposition pressure and substrate temperature conditions.

24. The method of claim 12 wherein the first period of time is less than the second period of time.

25. The method of claim 12 wherein the first period of time is no greater than 5 seconds.

26. The method of claim 12 wherein the first period of time is no greater than 3 seconds.

27. The method of claim 12 wherein the first feeding silane consists essentially of SiH_4 .

28. The method of claim 12 wherein the first feeding comprises plasma generation within the chamber.

29. The method of claim 12 wherein the first feeding does not comprise plasma generation within the chamber.

30. A plasma enhanced chemical vapor deposition method of forming a titanium silicide comprising layer over a substrate, comprising:

providing a substrate within a plasma enhanced chemical vapor deposition chamber at selected deposition pressure and substrate temperature conditions;

first feeding TiCl_4 and at least one silane to the chamber at a first volumetric ratio of TiCl_4 to silane of at least 500 for a first period of time and at the selected deposition pressure and substrate temperature conditions, the first volumetric ratio being sufficiently high to avoid measurable deposition of titanium silicide on the substrate; and

after the first feeding for the first period of time, second feeding TiCl_4 and at least one silane to the chamber at or below a second volumetric ratio of TiCl_4 to silane for a second period of time and at the selected deposition pressure and substrate temperature conditions, the second volumetric ratio being lower than the first volumetric ratio, the second feeding being effective to plasma enhance chemical vapor deposit a titanium silicide comprising layer on the substrate.

31. The method of claim 30 wherein the first volumetric ratio is 750:1.

32. The method of claim 30 wherein the first volumetric ratio is 1000:1.

33. The method of claim 30 wherein the first period of time is less than the second period of time.

34. The method of claim 30 wherein the first period of time is no greater than 5 seconds.

35. The method of claim 30 wherein the first feeding is at a substantially constant volumetric ratio of TiCl_4 to all silane during the first period of time.

36. The method of claim 30 wherein the first feeding is at multiple volumetric ratios of TiCl_4 to all silane during the first period of time.

37. The method of claim 30 wherein the feeding of TiCl_4 during the first and second feedings is at a substantially constant volumetric flow rate.

38. The method of claim 30 wherein the feeding of TiCl_4 during the first and second feedings is at different volumetric flow rates.

39. The method of claim 30 wherein the first feeding comprises plasma generation within the chamber.

40. The method of claim 30 wherein the first feeding does not comprise plasma generation within the chamber.